RATIONALE: *Subjecting approximately 10% of existing Delta leveed lands to tidal action and floodflows will greatly enhance the floodwater and sediment retention capacity of the Delta. The tracts at the south end of the Yolo Bypass, along the South Mokelumne River, and along the San Joaquin River channel are logical choices for this because they have limited levee systems and are already at high flood risk. These lands have had limited subsidence and offer good opportunities for restoring tidal wetland/slough complexes.*

The other significant area for setbacks is along the main channel of the San Joaquin River. "Cutting corners" on some islands where the levee length to land area maintained is now high would reduce levee construction and maintenance.

CENTRAL VALLEY STREAM TEMPERATURES

TARGET 1: More frequently maintain daily water temperatures in the Delta channels below 60°F in the spring and 65°F in the fall to meet the temperature needs of salmon and steelhead migrating through or rearing in the Delta (◆).

PROGRAMMATIC ACTION 1A: Improve riparian woodland habitats along migrating channels and sloughs of the Delta.

PROGRAMMATIC ACTION 1B: Improve SRA habitat along migration routes in Delta.

RATIONALE: *Maintaining water temperatures of less than 60°F in the spring and 65°F in the fall can improve survival of juvenile chinook salmon rearing in or migrating through the Delta. Maintaining maximum daily water temperatures in the channels and sloughs of the Sacramento-San Joaquin Delta Ecological Management Zone of less than 66°F in the fall will ensure healthy conditions for upstream migrating adult chinook salmon and early emigrating juveniles. Improved riparian habitat along Delta channels and the spring flow events should maintain cooler spring temperatures in dry and normal years. Improved riparian and SRA habitat will help to maintain lower Delta water temperatures from spring through fall.*

DELTA HYDRODYNAMICS

TARGET 1: Reestablish more natural internal Delta water flows in channels (◆◆◆).

PROGRAMMATIC ACTION 1A: Reduce velocities in selected Delta channels by increasing cross-sectional areas of channel by means of setback levees or by constricting flows into and out of the channels.

PROGRAMMATIC ACTION 1B: Increase tidal flow and cross-Delta transfer of water to south Delta pumping plants to selected channels to lessen flow through other channels.

PROGRAMMATIC ACTION 1C: Manage the operation of existing physical barriers so that resulting hydraulics upstream and downstream of the barrier are more like levels in the mid-1960s.

PROGRAMMATIC ACTION 1D: Close the DCC when opportunities allow, as specified in the 1995 Water Quality Control Plan and recommended by the U.S. Fish and Wildlife Service (1995), in the period from November through January when appropriate conditions trigger closure (i.e., internal Delta exports are occurring).

TARGET 2: Restore hydrodynamic conditions in the rivers and sloughs of the Delta sufficient to support targets for the restoration of aquatic resources (◆◆).

PROGRAMMATIC ACTION 2A: Restore 3,000 to 4,000 acres of tidal perennial aquatic habitat and 20,000 to 25,000 acres of tidally influenced freshwater marsh. *(Note: These recommendations are contained within programmatic actions presented in this section for tidal perennial aquatic habitat and fresh emergent wetland (tidal) and are not additions to acreages presented in the targets and programmatic actions for habitat.)*

TARGET 3: Maintain net downstream flows in the mainstem San Joaquin River from Vernalis to immediately west of Stockton from September through November to help sustain dissolved oxygen levels and water temperatures adequate for upstream migrating adult fall-run chinook salmon (◆◆).

PROGRAMMATIC ACTION 3A: Operate a barrier at the head of Old River from August through November.

TARGET 4: Restore 50 to 100 miles of tidal channels (303 to 606 acres) in the southern Yolo Bypass within the north Delta, while maintaining or improving the flood carrying capacity of the Yolo Bypass (◆). *(Note: This target is in addition to*

targets and programmatic actions presented in the Delta Slough habitat section.)

PROGRAMMATIC ACTION 4A: Construct a network of channels within the Yolo Bypass to connect the Putah and Cache Creek sinks, and potentially the Colusa drain, to the Delta. These channels should effectively drain all flooded lands in the bypass after floodflows stop entering the bypass from the Fremont and Sacramento weirs. The channels would maintain a base flow through the spring to allow juvenile anadromous and resident fish to move from rearing and migratory areas.

PROGRAMMATIC ACTION 4B: Reduce flow constrictions in the Yolo Bypass such as those in the openings in the railway causeway that parallels Interstate 80.

RATIONALE: *Internal Delta hydraulics have been highly modified since the early 1950s. Adverse hydraulic action has created poor conditions for sustaining spawning, rearing, and foodweb production in the Delta and for the transport of larval fish such as delta smelt and striped bass; (U.S. Fish and Wildlife Service 1994 Delta Smelt Biological Opinion; U.S. Fish and Wildlife Service 1995 Delta Smelt Opinion on the 1995 Water Quality Control Plan; U.S. Fish and Wildlife Service 1995; Independent Scientific Group 1996).*

Restoring hydraulic conditions within the Delta by modifying physical barriers in the Delta will support natural transport functions, reduce entrainment (in diversions) into parts of the Delta where survival is low, and assist in transporting juvenile fish into and through the Delta to highly productive nursery areas in the western Delta and Suisun Bay. Modifying DCC operation will restore historical hydraulic conditions in lower Mokelumne channels of the north Delta (U.S. Fish and Wildlife Service 1994 Delta Smelt Biological Opinion; U.S. Fish and Wildlife Service 1995 Delta Smelt Opinion on the 1995 Water Quality Control Plan; U.S. Fish and Wildlife Service 1995). Internal Delta hydraulics can be improved through several operational or structural approaches. The removal of structural barriers that alter internal Delta hydraulic patterns may be possible, depending on which alternative is selected.

Maintaining adequate flows past Stockton will improve existing harmful conditions of low dissolved oxygen and high water temperatures that can hinder the upstream movement of adult San Joaquin fall-run chinook salmon. In addition, improved flows past Stockton will reduce straying of adult salmon into Central and South Delta channels (California Department of Fish and Game 1972).

Improving the channel network in the Yolo Bypass will improve the migration pathway for salmon produced in Putah and Cache creeks, as well as for upper Sacramento River salmon using the Yolo Bypass as a pathway to the Delta. A well-drained system with permanent sloughs will keep juvenile salmon from being stranded in the bypass when flows stop. Permanent sloughs will provide valuable juvenile salmon rearing habitat in late winter and early spring.

Improving habitats along riparian corridors in the Yolo Bypass will provide additional spawning and rearing habitat for splittail and rearing and migration habitat for juvenile chinook salmon and perhaps for delta smelt and other native resident fishes. Conditions will also improve for wildlife and waterfowl.

Restoring connections among Delta channels, freshwater marsh, and seasonal wetland habitats will enhance habitat conditions for special-status species such as the splittail. Restoring this habitat connectivity in a large-scale mosaic in the North Delta will help restore the ecosystem processes and functions fundamental to supporting the foodweb and will improve conditions for rearing chinook salmon, steelhead, sturgeon, juvenile delta smelt, striped bass, and splittail (Fahrig and Merriam 1985).

BAY-DELTA AQUATIC FOODWEB

TARGET 1: Increase primary and secondary nutrient productivity in the Delta to levels historically observed in the 1960s and early 1970s (◆).

PROGRAMMATIC ACTION 1A: Actions described above to restore streamflow, floodplain flooding, Delta hydraulics, tidal wetlands and sloughs, and riparian habitat would increase primary and secondary productivity in the Delta. Relocating the intake of the South Delta pumping plants to the North Delta would also increase Delta productivity.

RATIONALE: *Increasing the area of tidal wetland/slough habitat and the residence time of*

Delta waters will increase primary and secondary productivity. More flooding of floodplains will provide more nutrients and organic carbon inputs to Delta waters. Relocating the intakes of the South Delta pumping plants will increase the residence time of Central and South Delta waters and allow more of the highly productive San Joaquin waters to be retained in the Delta.

HABITATS

GENERAL RATIONALE

Restoring wetland and riparian habitats along with tidal perennial aquatic habitats is an essential element of the restoration strategy for the Sacramento-San Joaquin Delta Ecological Management Zone. The general approach for habitat restoration is to mimic to the extent feasible a well-connected mosaic of aquatic and riparian habitats. In some areas, these habitat should be a contiguous as possible avoiding small habitat patches in favor of larger. Habitat corridors in the Delta should be emphasized that interconnect with habitat corridors on the main stem Sacramento and San Joaquin rivers as well as the eastside tributaries such as the Mokelumne River.

The extent and distribution of the land-water interface (contact) between aquatic habitats and interconnected wetland and riparian habitats have been altered since the mid-1850s by Delta reclamation. Since 1906, the amount of land-water interface has been reduced 32% in the East Delta Ecological Management Unit, 25% in the South Delta Ecological Management Unit, and 45% in the Central and West Delta Ecological Management Unit.

Increasing the ratio of land-water interface and increasing the shoreline perimeter will help restore a complex habitat mosaic on a large scale in the Delta. This will support essential ecosystem processes and functions. These measures are also fundamental to supporting the foodweb and improving conditions for rearing chinook salmon, steelhead, sturgeon, delta smelt, striped bass, and splittail. Foodweb support functions for wildlife will also benefit (Cummins 1974; Clark 1992).

Restoring high-quality freshwater marsh and brackish water marsh, both seasonal and permanent, will increase the production and availability of natural forage for waterfowl and other wildlife. This restoration will also increase the overwinter survival rates of wildlife that winter in this Ecological Management Zone and will strengthen them for migration, thus improving their breeding success. Expanding these habitats will also reduce the amount and concentrations of contaminants that could, upon entering the Delta's sloughs, damage the health of the aquatic resources.

The restoration of all habitats will be within the structure of adaptive management. The program will move forward in a step-wise progression. Each element will be designed with a testable hypothesis and a monitoring program to collect the scientific data needed to evaluate the hypothesis will be in place. Implementation will begin on a small scale and depending on the monitoring results will either continue or be modified based on results of completed projects.

CONVERSION OF LINEAR MEASURES TO ACREAGES

Generally, the June 1999 version of the ERP reported a mix of acres and miles of riparian and riverine aquatic habitats. In this revision, miles of riparian habitat are converted to acres using the following assumption: unless otherwise noted in the ERP, riparian stream corridors are assumed to be 100 feet wide. This equates to 12.12 acres of riparian habitat per mile of corridor for one side of a stream or 24.24 acres per mile including a riparian corridor on each side of the stream. Miles of riparian corridor the Delta and Suisun Marsh have been converted to acres using 12.12 acres per mile of riparian corridor to be restored or enhanced. This is deemed sufficient for analysis purposes as some riparian habitat will be present only on one side of a stream channel and actual width of the corridor will vary greatly from a screen of riparian vegetation in some areas to dense riparian stands that may be 200 feet wide. Riparian acres for the Delta and Suisun Marsh were calculated from the prescriptions in the riparian and riverine aquatic habitat targets presented in Volume II of the ERPP.

The ERP reports tidal and Delta sloughs as miles of sloughs to be restored. To improve evaluation of restoration of slough habitats, slough miles have been converted to acres (6.06 surface acres per mile). The single assumption for the calculation was that average slough width was 50 feet. This width reasonably

describes the range of widths present in natural or restored sloughs, with upper branches being considerably less than 50 feet wide and lower sections exceeding 50 feet.

TIDAL PERENNIAL AQUATIC HABITAT

TARGET 1: Restore 1,500 acres of shallow-water habitat in the North Delta Ecological Management Unit; 1,000 acres of shallow-water habitat in the East Delta Ecological Management Unit; 2,000 acres of shallow-water habitat in the South Delta Ecological Management Unit; and 2,500 acres of shallow-water habitat in the Central and West Delta Ecological Management Unit (◆◆).

PROGRAMMATIC ACTION 1A: Restore 500 acres of shallow-water habitat at Prospect Island in the North Delta Ecological Management Unit.

PROGRAMMATIC ACTION 1B: Restore 1,000 acres of shallow-water habitat in the downstream (south) end of the Yolo Bypass (Little Holland and Liberty islands) within the North Delta Ecological Management Unit.

PROGRAMMATIC ACTION 1C: Restore 1,000 acres of shallow-water habitat at the eastern edge of the East Delta Ecological Management Unit where existing land elevations range from 5 to 9 feet below mean sea level.

PROGRAMMATIC ACTION 1D: Restore 2,000 acres of shallow-water habitat at the south and eastern edge of the South Delta Ecological Management Unit where existing land elevations range from 5 to 9 feet below mean sea level.

PROGRAMMATIC ACTION 1E: Restore 2,500 acres of shallow-water habitat in the Central and West Delta Ecological Management Unit where existing land elevations range from 5 to 9 feet below mean sea level. A program of fill placement or longer-term subsidence reversal may be needed to accomplish this action.

PROGRAMMATIC ACTION 1F: Restore Frank's Tract to a mosaic of habitats using clean dredge materials and natural sediment accretion.

RATIONALE: *Restoring, improving, and protecting high-quality shallow-water habitat will provide greater foraging areas for rearing juvenile fish and waterfowl in this Ecological Management Zone. These areas typically provide high primary and secondary productivity and support nutrient cycling that sustains good forage. These areas also provide good forage for waterfowl that use underwater vegetation growing in the shoals and for diving ducks such as canvasback and scaup that eat clams (Fris and DeHaven 1993; Brittain et al. 1993; Stuber 1984; Shloss 1991; Sweetnam and Stevens 1993; San Francisco Estuary Project 1992a; U.S. Fish and Wildlife Service 1996; Lindberg and Marzuola 1993).*

Franks's Tract is a flooded Delta island that can be restored to a mosaic of habitat types with no impact to agriculture. Frank's Tract levees were breached and the island has been flooded since the early 1900s. The deep bed of the island does not provide good quality habitat for native fishes. Parts of the island could be elevated through a combination of dredge material placement, natural sediment accretion, and peat accumulation. Frank's Tract will be a functional component of the San Joaquin River corridor, a major fish rearing and migration area, as well as providing continuity with existing and other proposed habitats in the Central and West Delta Ecological Management Unit. Developing the tract must also occur in conjunction with the control or eradication of introduced, nuisance aquatic plants for restoration to be most beneficial to native species.

NONTIDAL PERENNIAL AQUATIC HABITAT

TARGET 1: Develop 500 acres of deep open-water areas (more than 4 to 6 feet deep) within restored fresh emergent wetlands in the Delta to provide resting habitat for water birds, foraging habitat for diving ducks and other water birds and semi-aquatic mammals that feed in deep water, and habitat for associated resident pond fish species (◆).

PROGRAMMATIC ACTION 1A: Develop 100 acres of open-water areas within restored fresh emergent wetland habitats in the West and Central Delta Ecological Management Unit such as on Twitchell or Sherman islands.

PROGRAMMATIC ACTION 1B: Develop 200 acres of open-water areas within restored fresh emergent wetland habitats in the East Delta Ecological Management Unit.

PROGRAMMATIC ACTION 1C: Develop 200 acres of open-water areas within restored fresh

emergent wetland habitats in the South Delta Ecological Management Unit.

TARGET 2: Develop 2,100 acres of shallow, open-water areas (less than 4 to 6 feet deep) in restored fresh emergent wetland habitat areas in the Delta to provide resting, foraging, and brood habitat for water birds and habitat for fish and aquatic plants and semi-aquatic animals (◆◆).

PROGRAMMATIC ACTION 2A: Develop 500 acres of shallow, open-water areas within restored fresh emergent wetland habitats in the Central and West Delta Ecological Management Unit such as on Twitchell or Sherman Islands.

PROGRAMMATIC ACTION 2B: Develop 300 acres of shallow, open-water areas within restored fresh emergent wetland habitats in the East Delta Ecological Management Unit.

PROGRAMMATIC ACTION 2C: Develop 300 acres of shallow, open-water areas within restored fresh emergent wetland habitats in the South Delta Ecological Management Unit.

PROGRAMMATIC ACTION 2D: Develop 1,000 acres of shallow, open-water areas within restored fresh emergent wetland habitats in the North Delta Ecological Management Unit.

RATIONALE: *Restoring suitable resting areas for waterfowl and other wetland-dependent wildlife such as river otter will increase their over-winter survival rate. Other water-associated wildlife will also benefit (Madrone and Associates 1980).*

Restoring suitable resting areas for waterfowl and other wetland-dependent wildlife such as river otter will increase their over-winter survival rates. Other water-associated wildlife will also benefit (Madrone and Associates 1980).

Implementation of actions designed to increase or improve acreages of nontidal perennial aquatic habitats need to develop or integrate subsidence reversal and sediment accretion. These will assist in raising bottom elevations to levels that can support rooted submergent and emergent vegetation.

DELTA SLOUGHS

TARGET 1: Restore ecological structure and functions of the Delta waterways network by increasing the land-water interface ratio a minimum of 50% to 75% compared to 1906 conditions and by restoring 65 to 165 miles of small distributary sloughs (less than 50 to 75 feet wide) hydrologically connected to larger Delta channels (◆◆). *(Note: This target is in addition to the Delta slough target presented in the target section for Delta Channel Hydraulics.)*

PROGRAMMATIC ACTION 1A: To replace lost slough habitat and provide high-quality habitat areas for fish and associated wildlife, the short-term solution for the Central and West Delta Ecological Management Unit is to restore 20 miles of slough habitat. The long-term solution is to restore 50 miles of slough habitat (121-303 acres). In each the North Delta and East Delta Ecological Management Units, the short-term solution is to restore 10 miles of slough habitat. The long-term solution is to restore 30 miles of slough habitat (61-182 acres, each). In the South Delta Ecological Management Unit, the short-term solution is to restore 25 miles of slough habitat and the long-term solution is to restore 50 miles of slough habitat (152-303 acres).

PROGRAMMATIC ACTION 1B: Restore tidal action to portions of islands and tracts in the North and East Delta Ecological Management Units with appropriate elevation, topography, and water-landform conditions. This will sustain tidally influenced freshwater marshes with 20 to 30 linear miles (121-182 acres) of narrow, serpentine-shaped sloughs within the wetlands and floodplain. *(Note: The slough miles, or total acreages, are not additive to acreages presented for tidal fresh emergent wetland habitat. A key in restoring tidal habitats includes provision for tidal sloughs and upland transition habitats.)*

RATIONALE: *Restoring, improving, and protecting sloughs in the Ecological Management Units of the Sacramento-San Joaquin Delta Ecological Management Zone will help sustain high-quality shallow-water habitat for spawning of native fish and for foraging of juvenile fish. Restoring small dead-end sloughs and tidally influenced freshwater marshes and mudflats in the Sacramento-San Joaquin Delta Ecological Management Zone will provide habitat for spawning of native fish and for foraging of juvenile fish, increase production of primary and secondary food species, and support nutrient cycling that sustains quality forage. These sloughs can also provide loafing sites for waterfowl and habitat for the*

western pond turtle (Simenstad et al. 1992 and 1993; Lindberg and Marzuola 1993; Madrone and Associates 1980).

Land-water interface targets represent a reasonable level necessary to restore Bay-Delta ecosystem functions and overall health by increasing water-to-perimeter shoreline ratios and patterns to those of the early 1900s. Delta slough habitat will be restored as a mosaic of habitats including slough, tidal perennial, and tidal emergent habitats.

MIDCHANNEL ISLANDS AND SHOALS

TARGET 1: Maintain existing channel islands and restore 50 to 200 acres of high-value islands in selected sloughs and channels in each of the Delta's Ecological Management Units (◆◆).

PROGRAMMATIC ACTION 1A: Actively protect and improve existing channel islands in the Delta.

PROGRAMMATIC ACTION 1B: Restore 50 to 200 acres of channel islands in the Delta where channel islands once existed.

TARGET 2: Restore 500 acres of shoals in the westernmost portion of the Central and West Delta (◆◆).

PROGRAMMATIC ACTION 2A: Implement a sediment management program that results in deposition and accretion within portions of Central and West Delta channels and bays, forming 500 acres of shallow shoal habitat restored to tidal influence.

RATIONALE: *Many of the remnant channel or "berm" islands in the Delta have been lost to continuing erosion and degradation. Restoring, improving, and protecting the riverine-edge habitat of these islands will provide habitat for juvenile salmon rearing in this Ecological Management Zone. Terrestrial vertebrates that will receive indirect benefits include the western pond turtle and shorebirds and wading birds (Fris and DeHaven 1993; Mahoney and Ermin 1984; Knight and Bottorf 1983; Knox 1984; Novick and Hein 1982; Moore and Gregory 1988; May and Levin 1991; Levin et al. 1995).*

Restoring, improving, and protecting high-quality shallow habitat will provide forage for rearing juvenile fish. These habitats typically provide high levels of primary (plant) and secondary (animal) productivity and support nutrient cycling functions that can sustain quality forage. These habitats also provide high-quality forage habitat for waterfowl who use submergent vegetation growing in the shoals and diving ducks such as canvasback and scaup that eat clams (Fris and DeHaven 1993; Brittain et al. 1993; Stuber 1984).

Restoring high-quality brackish tidal marshes on and adjacent to these islands will contribute to cycling nutrients, maintaining the foodweb, and increasing production of primary and secondary food species in a geographic location already noted for its value as a rearing habitat for estuarine fish. Several plant species of special concern such as the Suisun aster will benefit from increasing the area of brackish tidal marsh in the Delta (Landin and Newling 1988; Dionne et al. 1994; Lindberg and Marzuola 1993).

FRESH EMERGENT WETLAND HABITAT (TIDAL)

TARGET 1: Increase existing tidal freshwater marsh habitat in the Delta by restoring 30,000 to 45,000 acres of lands designated for floodplain restoration (◆◆).

PROGRAMMATIC ACTION 1A: Develop tidal freshwater marshes in the North Delta Ecological Management Unit.

PROGRAMMATIC ACTION 1B: Develop tidal freshwater marshes on small tracts of converted leveed lands along Snodgrass Slough.

PROGRAMMATIC ACTION 1C: Develop tidal freshwater marshes along the upper ends of dead-end sloughs in the east Delta.

PROGRAMMATIC ACTION 1D: Develop tidal freshwater marshes along all setback levees and levees with restored riparian habitat.

PROGRAMMATIC ACTION 1E: Develop tidal freshwater marshes on restored channel island habitat. *(Note: Any tidal freshwater marsh habitat developed is included in Target 1 for this habitat type.)*

RATIONALE: *Restoring tidally influenced freshwater marshes in the Sacramento-San Joaquin Delta Ecological Management Zone will increase*

production of primary and secondary food species and support nutrient cycling functions that can sustain quality forage conditions for fish, waterfowl, shorebirds, and wildlife (Lindberg and Marzuola 1993; Miller 1993; Simenstad et al. 1992 and 1993). Increasing the area of freshwater tidal marshes in each of the four Delta Ecological Management Units will help support the proper aquatic habitat for rearing and outmigrating juvenile chinook salmon, steelhead, and sturgeon and for rearing delta smelt, striped bass, and splittail. Restoring high-quality freshwater marshes, both tidal and nontidal, will contribute to nutrient cycling, maintaining the foodweb, and increased production of primary and secondary food species. In addition, increasing the area of freshwater marsh will contribute to an ecosystem that can accommodate sea level rise. This can only be effective, however, if upland migration corridors are available for the marshes to expand as sea level rises.

The targets selected take into account the large losses of tidal freshwater marshes since the early 1900s. The Sacramento-San Joaquin Delta Ecological Management Zone lost nearly 90,000 acres, with the greatest losses in the North Delta and Central and West Delta Ecological Management Units. Acreage changes in the South Delta were insignificant during that period because most losses these occurred before 1900. Restoration targets are to restore between 30% and 50% of the losses since 1900. The level of restoration was increased in the South Delta because of the prior losses documented by Landin and Newling (1988). There was a substantial loss of fresh emergent wetlands in the South Delta Ecological Management Unit prior to the 1900s and a significant amount of wetlands could be restored.

FRESH EMERGENT WETLAND HABITAT (NONTIDAL)

TARGET 1: Restore a total of 2,000 acres of nontidal freshwater marshes in the North Delta Ecological Management Unit and 1,000 acres in the East Delta Ecological Management Unit; restore 4,000 acres of nontidal fresh emergent wetland in the South Delta Ecological Management Unit as part of a subsidence control program; and restore 10,000 acres of nontidal fresh emergent wetland in the Central and West Delta Ecological Management Unit as part of a subsidence control program (total of 17,000 acres) (◆◆).

PROGRAMMATIC ACTION 1A: Restore 1,000 acres of nontidal freshwater marshes on Twitchell Island.

PROGRAMMATIC ACTION 1B: Restore 1,000 acres of nontidal freshwater marshes in the Yolo Bypass.

PROGRAMMATIC ACTION 1C: Restore 1,000 acres of nontidal freshwater marshes in leveed lands designated for floodplain overflow adjacent to the dead-end sloughs in the East Delta Ecological Management Unit.

PROGRAMMATIC ACTION 1D: Restore 4,000 acres of nontidal freshwater marshes in the South Delta in lands designated for floodplain overflow.

PROGRAMMATIC ACTION 1E: Restore 10,000 acres of nontidal freshwater marshes on Delta Islands of the Central and West Delta Ecological Management Unit. *(Note: Up to 75% of this acreage may be restored to tidal actions after the appropriate land elevations are achieved through island accretion. Upon restoring tidal action, targets for the Central and West Delta Ecological Management Unit would be adjusted to avoid the need to restore additional non-tidal wetland above 2,500 acres.)*

RATIONALE: *The restoration of high-quality nontidal freshwater marshes will contribute to nutrient cycling, maintaining the foodweb, and supporting enhanced levels of primary and secondary food production. Increasing the areal extent of nontidal freshwater marsh in the Delta, particularly in the Central and West Delta Ecological Management Unit, will be an important component of subsidence control and island accretion. Permanent freshwater marsh can help arrest and in some cases reverse subsidence where peat oxidation has resulted in land elevations more than 15 feet below sea level. Increasing the area of freshwater marsh will contribute to an ecosystem that can accommodate sea level rise. Habitats for wetland wildlife will be improved. The targets selected take into account the large losses of nontidal freshwater marshes since the early 1900s. The Sacramento-San Joaquin Delta Ecological Management Zone lost nearly 90,000 acres with the greatest losses in the North Delta and Central and West Delta Ecological Management Units. Acreage changes in the South Delta were insignificant during that period because most losses there occurred before 1900.*

SEASONAL WETLAND HABITAT

TARGET 1: Restore and manage at least 2,000 acres of additional seasonal wetland habitat and improve management of 1,000 acres of existing, degraded seasonal wetland habitat in the North Delta Ecological Management Unit (◆◆).

PROGRAMMATIC ACTION 1A: Improve management of 1,000 acres of existing, degraded seasonal wetland habitat in the Yolo Bypass.

PROGRAMMATIC ACTION 1B: Restore and manage 2,000 acres of additional seasonal wetland habitat in association with the Yolo Basin Wildlife Area.

TARGET 2: Restore and manage at least 6,000 acres of additional seasonal wetland habitat and improve management of 1,000 acres of existing, degraded seasonal wetland habitat in the East Delta Ecological Management Unit (◆◆).

PROGRAMMATIC ACTION 2A: Develop a cooperative program to restore and manage 1,000 acres of additional seasonal wetland habitat on Canal Ranch.

PROGRAMMATIC ACTION 2B: Develop a cooperative program to restore and manage 5,000 acres of additional seasonal wetland habitat.

PROGRAMMATIC ACTION 2C: Improve management of 1,000 acres of existing degraded seasonal wetland habitat.

TARGET 3: Restore and manage at least 8,000 acres of additional seasonal wetland habitat and improve management of 1,500 acres of existing, degraded seasonal wetland habitat in the Central and West Delta Ecological Management Unit (◆◆).

PROGRAMMATIC ACTION 3A: Restore and manage 4,000 acres of additional seasonal wetland habitat on Twitchell Island.

PROGRAMMATIC ACTION 3B: Restore and manage 4,000 acres of additional seasonal wetland habitat on Sherman Island.

PROGRAMMATIC ACTION 3C: Develop a cooperative program to improve management of 1,500 acres of existing degraded seasonal wetland habitat.

TARGET 4: Restore and manage at least 12,000 acres of additional seasonal wetland habitat and improve management of 500 acres of existing, degraded seasonal wetland habitat in the South Delta Ecological Management Unit (◆◆).

PROGRAMMATIC ACTION 4A: Develop a cooperative program to restore and manage 12,000 acres of additional seasonal wetland habitat.

PROGRAMMATIC ACTION 4B: Develop a cooperative program to improve management of 500 acres of existing degraded seasonal wetland habitat.

RATIONALE: *Restoring seasonal wetland habitats along with aquatic, permanent wetland, and riparian habitats is an essential element of the restoration strategy for the Sacramento-San Joaquin Delta Ecological Management Zone. Restoring the ratio of land-water interface will help restore a mosaic of complex habitats that will restore important ecosystem processes and functions. Restoring these habitats will also reduce the amount and concentrations of contaminants that could, once they enter the Delta's sloughs, interfere with restoring the ecological health of the aquatic ecosystem. Seasonal wetlands support a high production rate of primary and secondary food species and large blooms (dense populations) of aquatic invertebrates.*

Wetlands that are dry in summer are also efficient sinks for the transformation of nutrients and the breakdown of pesticides and other contaminants. The roughness of seasonal wetland vegetation filters and traps sediment and organic particulates. Water flowing out from seasonal wetlands is typically high in foodweb prey species concentrations and fine particulate organic matter that feed many Delta aquatic and semiaquatic fish and wildlife. To capitalize on these functions for the Delta aquatic zone, significant areas of restored seasonal wetlands in the Sacramento-San Joaquin Delta Ecological Management Zone should be subject to periodic flooding and overland flow from Delta and river floodplains.

RIPARIAN AND RIVERINE AQUATIC HABITATS

TARGET 1: Restore 10 to 20 linear miles of riparian and riverine aquatic habitat along the San Joaquin River in the South Delta Ecological Management Unit to create corridors of riparian vegetation of

which 60% is to be over 75 feet wide and 40% is to be no less than 300 feet wide and 1 mile long (200 to 400 acres) (◆◆).

PROGRAMMATIC ACTION 1A: Develop a cooperative program to restore riparian habitat either by obtaining conservation easements or by purchase from willing sellers.

TARGET 2: Restore 15 to 25 linear miles of riparian and riverine aquatic habitat along other Delta island levees throughout the South Delta Ecological Management Unit. This will create riparian vegetation corridors of which 90% is to be more than 75 feet wide and 10%, no less than 300 feet wide and 1 mile long (177 to 295 acres) (◆◆).

PROGRAMMATIC ACTION 2A: Develop a cooperative program to restore riparian habitat either by obtaining conservation easements or by purchase from willing sellers.

TARGET 3: Restore 10 to 15 linear miles of riparian and riverine aquatic habitat in the North Delta Ecological Management Unit along the Sacramento River below Sacramento of which 80% is to be more than 75 feet wide and 20% over 300 feet wide (145 to 218 acres)(◆).

PROGRAMMATIC ACTION 3A: Obtain conservation easements for, or purchase from willing sellers, land needed to restore 10 to 15 linear miles of riparian habitat along the Sacramento River in the North Delta Ecological Management Unit. Obtain conservation easements for, or purchase from willing sellers, land needed to create corridors of riparian vegetation.

TARGET 4: Restore 8 to 15 linear miles of riparian and riverine aquatic habitat in the East Delta Ecological Management Unit of which 80% is to be more than 75 feet wide and 20% over 300 feet wide (116 to 218 acres)(◆◆).

PROGRAMMATIC ACTION 4A: Obtain conservation easements for, or purchase from willing sellers, land needed to restore 5 to 10 linear miles along the Mokelumne River and 3 to 5 miles along the Cosumnes River in the East Delta Ecological Management Unit to create corridors of riparian vegetation.

TARGET 5: Restore 10 to 20 linear miles of riparian and riverine aquatic habitat in the North Delta Ecological Management Unit of which 80% is to be more than 75 feet wide and 20% over 300 feet wide (145 to 291 acres)(◆◆).

PROGRAMMATIC ACTION 5A: Obtain conservation easements for, or purchase from willing sellers, land needed to restore 5 to 10 linear miles along the Steamboat Slough as part of the development of a North Delta Habitat Corridor.

TARGET 6: Restore or plant riparian and riverine aquatic habitats and recreate slough habitat and set back levees (◆).

PROGRAMMATIC ACTION 6A: Obtain conservation easements for, or purchase from willing sellers, land needed to restore riparian habitat along newly created sloughs and sloughs with new levee setbacks.

PROGRAMMATIC ACTION 6B: Obtain conservation easements for, or purchase from willing sellers, land needed to restore riparian habitat along new or upgraded Delta levees.

TARGET 7: Protect existing riparian woodlands in North, East, and South Delta Ecological Management Units (◆◆).

PROGRAMMATIC ACTION 7A: Expand the Stone Lakes and Cosumnes River Preserves from their current size by an additional 500 acres of existing woodland habitat. Share costs with the Nature Conservancy to acquire in-fee title to the lands needed from willing landowners.

PROGRAMMATIC ACTION 7B: Purchase riparian woodland property or easements.

RATIONALE: *Many species of wildlife, including several species listed as threatened or endangered under the State and federal Endangered Species Acts and several special-status plant species in the Central Valley are dependent on or closely associated with riparian habitats. Riparian habitats support a greater diversity of wildlife species than any other habitat type in California. Degradation and loss of riparian habitat have substantially reduced the habitat area available for associated wildlife species. Loss of this habitat has reduced water storage, nutrient cycling, and foodweb support.*

Restoring, improving, and protecting high-quality riparian woodland habitat will enhance nutrient

cycling and foodweb support and provide habitat for terrestrial invertebrates that will sustain resident fish and rearing juvenile anadromous fish in the Delta. Terrestrial vertebrates that will benefit include the Swainson's hawk, western yellow-billed cuckoo, wading birds, neotropical birds, and the riparian brush rabbit. This habitat will also increase suitable habitat for wildlife such as the western pond turtle and wood duck (Bjornn et al. 1991; Shields et al. 1993; Jensen et al. 1987; Fris and DeHaven 1993; Mahoney and Erman 1984; Knight and Bottorff 1983).

Large-scale riparian restoration projects are needed to restore the biodiversity (variety of species) and the sustainability and resilience of these habitats. This is consistent with the recommended strategy for restoration of rivers and aquatic ecosystems on a large landscape scale (National Research Council 1992; Noss and Harris 1986; Hutto et al. 1987; Scott et al. 1987; Noss et al. 1994). Large-scale restoration of broad, diverse riparian habitats in the Sacramento-San Joaquin Delta Ecological Management Zone will support increased nesting populations of Swainson's hawks and other raptors, as well as the yellow-billed cuckoo. Wood ducks will also benefit from increases in riparian habitat. Heron and egret rookeries will increase as well (Baltz and Moyle 1984; Hudson 1991; Motroni 1981; National Resource Council 1992; Gaines 1974 and 1977).

Riparian woodland habitats are important habitat use areas for many species of wildlife in the Central Valley. The loss or degradation of historic stands of riparian woodland has substantially reduced the habitat area available for associated wildlife. Such woodlands will also contribute to the recovery of species such as Swainson's hawk. Actions to restore ecological processes and functions, increase and improve habitats, and reduce stressors are prescribed primarily to contribute to the recovery of aquatic species such as winter-run, spring-run, and late-fall-run chinook salmon; splittail; and delta smelt. These actions will also benefit the Swainson's hawk, greater sandhill crane, yellow-billed cuckoo, riparian brush rabbit, black rail, and giant garter snake.

INLAND DUNE SCRUB

TARGET 1: Enhance 50 to 100 acres of low- to moderate-quality Antioch inland dune scrub habitat in the Delta to provide high-quality habitat for special-status plant and animal species and associated wildlife (◆◆).

PROGRAMMATIC ACTION 1A: Support programs for protecting and restoring inland dune scrub habitat at existing ecological preserves in the Central and West Delta Ecological Management Unit.

PROGRAMMATIC ACTION 1B: Protect and restore inland dune scrub habitat areas adjacent to existing ecological preserves in the Central and West Delta Ecological Management Unit through either conservation easements or purchase from willing sellers.

RATIONALE: *An analysis of soils indicated that the historical extent of inland sand dunes in the Delta was probably less than 10,000 acres. The extent and habitat quality of inland dune scrub has declined as a result of recent land use changes. Inland dune scrub is a unique Delta community and supports several special-status plant and animal species, including the Lange's metalmark, which is federally listed as endangered. Protection and restoration of inland dune scrub habitat will help maintain existing special-status species and assist in recovery of their populations.*

FRESHWATER FISH HABITAT AND ESSENTIAL FISH HABITAT

TARGET 1: Maintain and improve existing freshwater fish habitat and essential fish habitat through the integration of actions described for ecological processes, habitats, and stressor reduction or elimination (◆).

PROGRAMMATIC ACTIONS: No additional programmatic actions are recommended.

RATIONALE: *Freshwater fish habitat and essential fish habitat are evaluated in terms of their quality and quantity. Actions described for Delta ecological processes, stressor reduction, and riparian and riverine aquatic habitat should suffice to maintain and restore freshwater fish habitats. For example, maintaining freshwater and essential fish habitats is governed by actions to maintain streamflow, improve coarse sediment supplies, maintain stream meander, maintain or restore connectivity of rivers and streams and their floodplains, and in maintaining and restoring riparian and riverine aquatic habitats.*